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TSSG/RED/ATB-049-70
25 February 1970

MEMORANDUM FOR THE RECORD

SUBJECT: Generation of Color Gamut of SO-242 Film

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1. [] TSSG/RED/ATB, has examined the possibility of determining the color gamut of original positive color film type SO-242. [] under [] has proposed generation of this color gamut which will provide a mechanism of converting from color sensitometric data to C.I.E. chromaticity coordinates.

2. The color gamut of a photographic film is the set of colors it can reproduce with the dyes used in that particular film. The dyes used in color films are cyan (absorbs red, transmits blue and green), yellow (absorbs blue, transmits red and green) and magenta (absorbs green, transmits red and blue). Varying combinations of these dyes, taken one, two, or three at a time produce the gamut of a color film. The boundaries of the color gamut, when plotted on the C.I.E. chromaticity diagram, as shown on the attachment, specify the purest colors (most highly saturated) the film can produce.

3. The color gamut (also called chromaticity grid), serves as a means of translating from Equivalent Neutral Densities (E.N.D.'s) to C.I.E. chromaticity coordinates. E.N.D.'s are a measure of a given dye's contribution to a neutral of a known density. For example, if we have a patch of cyan dye, which when mixed with the correct amounts of yellow and magenta dye forms a neutral of a density of 1.00, we say that the cyan dye had an E.N.D. of 1.00.

4. The advantage of this translation from E.N.D.'s to C.I.E. chromaticity coordinates is that E.N.D.'s can be determined from a properly calibrated micro or macrodensitometer. The calibration procedure requires three color filter measurements to be made on the individual dye layers of the film to be measured. It would be necessary to have cyan, magenta and yellow step wedges from SO-242 if we want to determine the E.N.D.'s of this film. It is also necessary to have a series of neutrals produced on this film. The densitometer data would then have to be mathematically transformed and calibration equations developed. After this was done, it would only be necessary to keep the densitometers in control. When mission material on SO-242 was scanned the densitometer output from the red, green and blue filter readings would have to be multiplied by a constant and E.N.D. values would result. From these E.N.D. values the chromaticity coordinates could be found.

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5. The immediate advantage of this routine is that chromaticity coordinates, and their corresponding Munsell colors could be identified without using the conventional color measurement instruments, the spectrophotometer or colorimeter. These devices require computer manipulation of their output data; the E.N.D. to C.I.E. color gamut requires only a table or overlay for the conversion.

6. To produce the color gamut it is necessary to generate the single dye layer step wedges, a series of neutrals and the various (total 2700) dye patches. For accuracy in the conversion grid, E.N.D.'s from .10 to 3.00 at E.N.D. steps of .10 were chosen. Since any combination of the three dyes (cyan, magenta and yellow) produces a neutral, it is only necessary to take each of the three dyes, two at a time. That is, a series of cyan and magenta combinations at the E.N.D. range of 3.00 and steps of .10 E.N.D. will be made. This results in 900 samples. The same will be done for combinations of cyan and yellow and yellow and magenta. This results in 2700 patches. These patches will be read on a densitometer for E.N.D. values and a colorimeter for C.I.E. chromaticity coordinates; the table will be generated from this data.

7. It has been suggested in the literature that generation of this color gamut may be done via computer with knowledge of only the spectrophotometric characteristics of the three dyes. Taking combinations of these dyes and determining the chromaticity coordinates is a straight forward computer exercise. I discussed this possibility with [REDACTED]

[REDACTED] He indicated that this technique would be subject to failure above E.N.D.'s of 1.0 to 1.5, where Beer's law might not hold. [REDACTED] RED/ATB, has generated a computer program for generation of these gamut; the possibility exists that if the computer data matches a significant number of samples at specified E.N.D. values it will not be necessary to generate and measure all 2700 patches. This will have to be investigated midway through the program, at which time a decision could be made.

8. The techniques as described in this proposal and the resultant information to be gained are described in the references on color photography, most-directly in Evans, Hanson and Brewer, Principles of Color Photography. The information that would be provided would be most significant and the ATB would have available a very important tool of color image analysis and color specification. It is important to note, however, that the many steps and mathematical treatment of data may place a limit on the ultimate accuracy of this system. For the most precise color measurement a spectrophotometer is the desired instrument to use; for convenience of use and ability to measure small areas with equipments presently available in NPIC, the color gamut is the most convenient and direct method of measure.

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25X1 9. An attempt was made to get this information from the [] but at the present time they indicate it is not available. For this reason, [] who has done similar work with other color materials has been given approval to perform this task. It has been estimated to cost [] covering eight months in the two fiscal years of 1970 and 1971. Processing of the material will be done at the [] and a courier will transfer the film from [] and back to Data Corporation as needed.

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TSSG/RED/ATB/EL

Attachment: As stated

Distribution:

Orig. - Route & file

- 1 - CH/TSSG/RED
- 1 - CH/TSSG/APSD/ISAB
- 1 - CH/TSSG/RED/RSB
- 1 - TSSG/RED/SRB (4 [])
- 1 - CH/PSG/RD/PSB
- 1 - IEG/OD (Attn: [])

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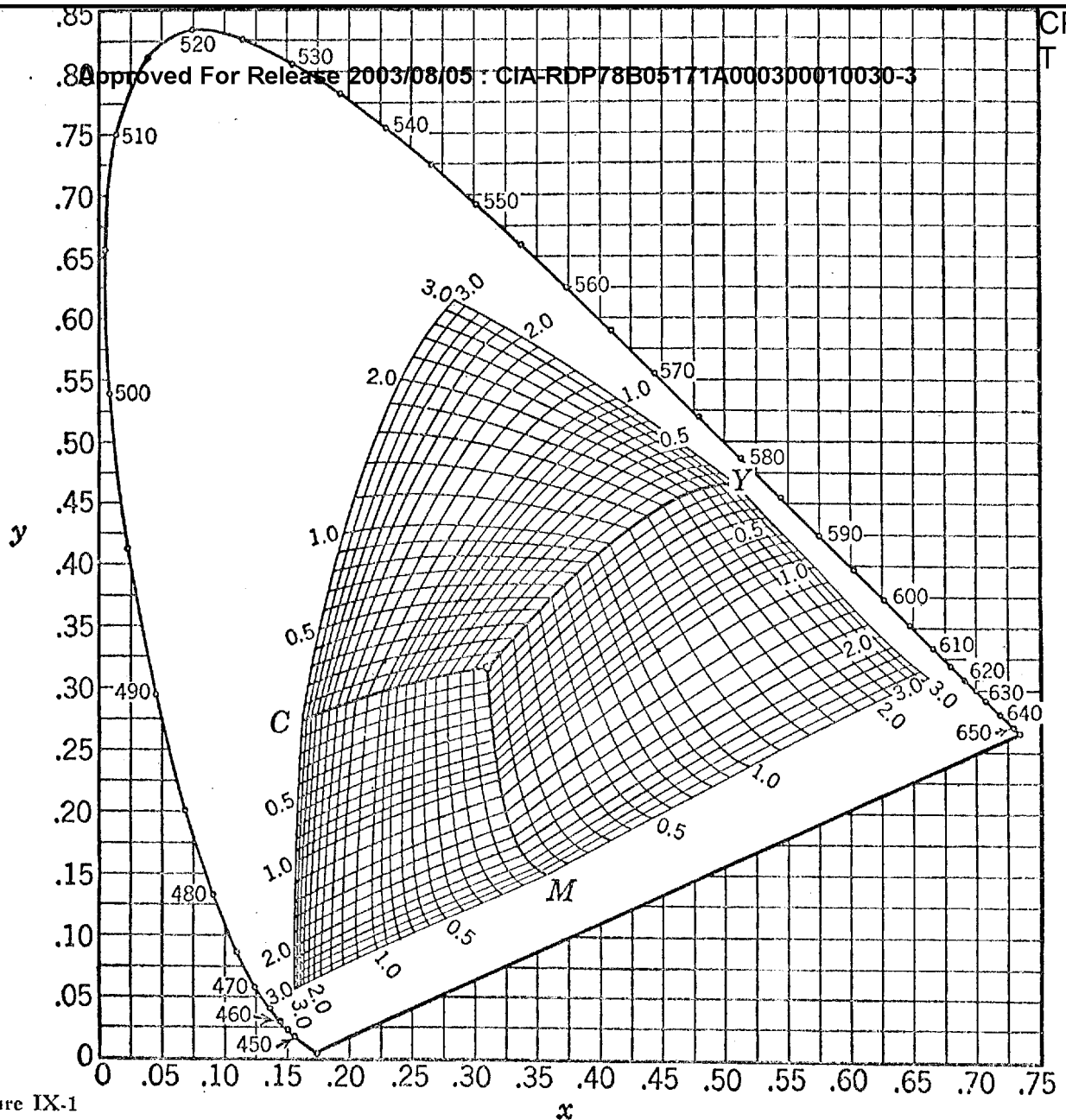


Figure IX-1

Chromaticity grid for a set of photographic dyes, with CIE Illuminant C. The numbers on the grid

* indicate the END's of the dye components. (Evans, Hanson, and Brewer p. 511).